

## NCE P-Channel Enhancement Mode Power MOSFET

### Description

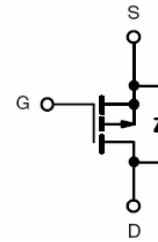
The NCE2301 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 2.5V. This device is suitable for use as a load switch or in PWM applications.

### General Features

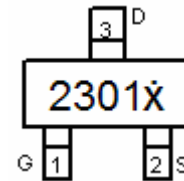
- $V_{DS} = -20V, I_D = -3A$   
 $R_{DS(ON)} < 140m\Omega @ V_{GS} = -2.5V$   
 $R_{DS(ON)} < 110m\Omega @ V_{GS} = -4.5V$
- High power and current handling capability
- Lead free product is acquired
- Surface mount package

### Application

- PWM applications
- Load switch
- Power management



Schematic diagram



Marking and pin assignment



SOT-23 top view

### Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
2301 X	NCE2301	SOT-23	Ø180mm	8 mm	3000 units

### Absolute Maximum Ratings ( $T_A=25^\circ C$ unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	-20	V
Gate-Source Voltage	$V_{GS}$	$\pm 12$	V
Drain Current-Continuous	$I_D$	-3	A
Drain Current -Pulsed <sup>(Note 1)</sup>	$I_{DM}$	-10	A
Maximum Power Dissipation	$P_D$	1	W
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 150	$^\circ C$

### Thermal Characteristic

Thermal Resistance, Junction-to-Ambient <sup>(Note 2)</sup>	$R_{\theta JA}$	125	$^\circ C/W$
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### Electrical Characteristics ( $T_A=25^\circ C$ unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=-250\mu A$	-20	-24	-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=-20V, V_{GS}=0V$	-	-	-1	$\mu A$

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 12V, V_{DS}=0V$	-	-	$\pm 100$	nA
<b>On Characteristics</b> (Note 3)						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=-250\mu A$	-0.4	-0.7	-1	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=-4.5V, I_D=-3A$	-	64	110	m $\Omega$
		$V_{GS}=-2.5V, I_D=-2A$	-	89	140	m $\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS}=-5V, I_D=-2A$	5	-	-	S
Gate resistance	$R_G$	$F=1.0MHz$	-	6.6	-	$\Omega$
<b>Dynamic Characteristics</b> (Note 4)						
Input Capacitance	$C_{iss}$	$V_{DS}=-10V, V_{GS}=0V,$ $F=1.0MHz$	-	841	-	PF
Output Capacitance	$C_{oss}$		-	75	-	PF
Reverse Transfer Capacitance	$C_{rss}$		-	47	-	PF
<b>Switching Characteristics</b> (Note 4)						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=-10V, I_D=-1A$ $V_{GS}=-4.5V, R_{GEN}=10\Omega$	-	11	-	nS
Turn-on Rise Time	$t_r$		-	35	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	30	-	nS
Turn-Off Fall Time	$t_f$		-	10	-	nS
Total Gate Charge	$Q_g$	$V_{DS}=-10V, I_D=-3A,$ $V_{GS}=-2.5V$	-	3.3	12	nC
Gate-Source Charge	$Q_{gs}$		-	0.7	-	nC
Gate-Drain Charge	$Q_{gd}$		-	1.3	-	nC
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage (Note 3)	$V_{SD}$	$V_{GS}=0V, I_S=1.3A$	-	-	-1.2	V
Diode Forward Current (Note 2)	$I_S$		-	-	-3	A

### Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production

Typical Electrical and Thermal Characteristics

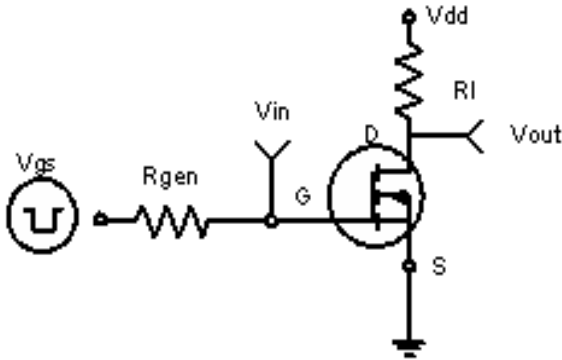


Figure 1: Switching Test Circuit



Figure 2: Switching Waveforms

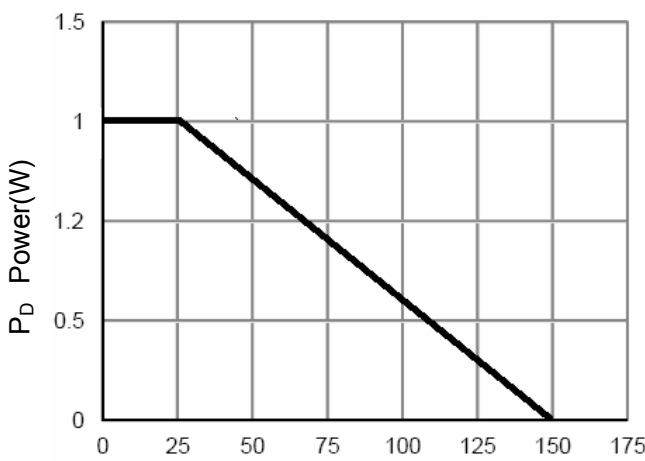


Figure 3 Power Dissipation

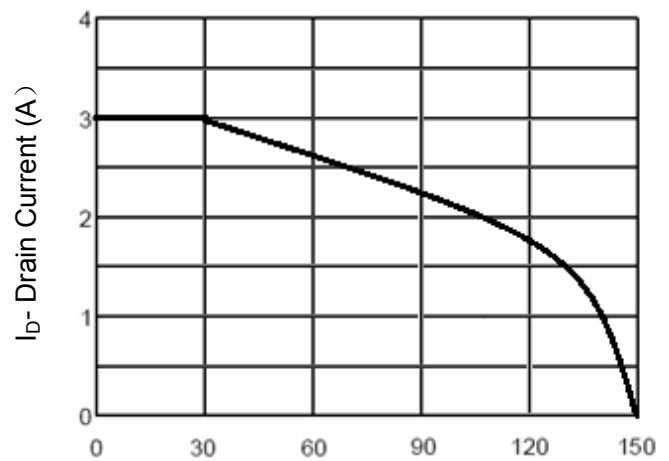


Figure 4 Drain Current

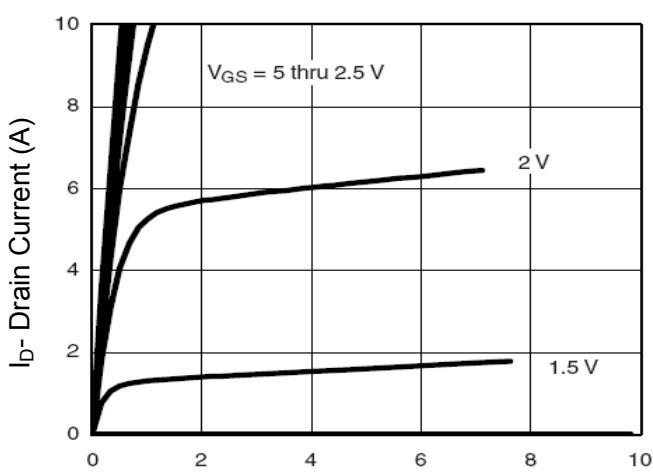


Figure 5 Output Characteristics

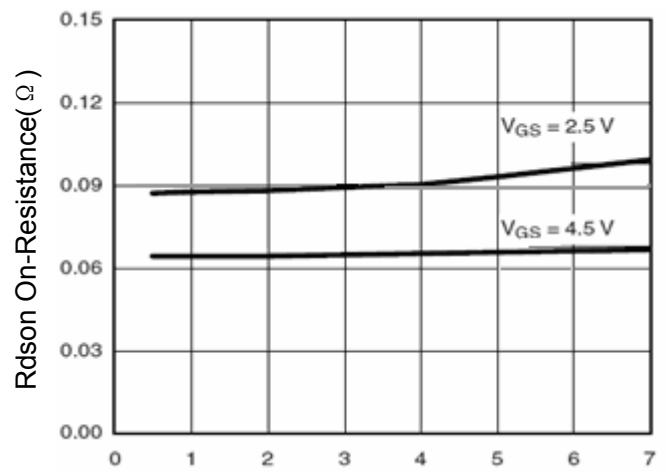
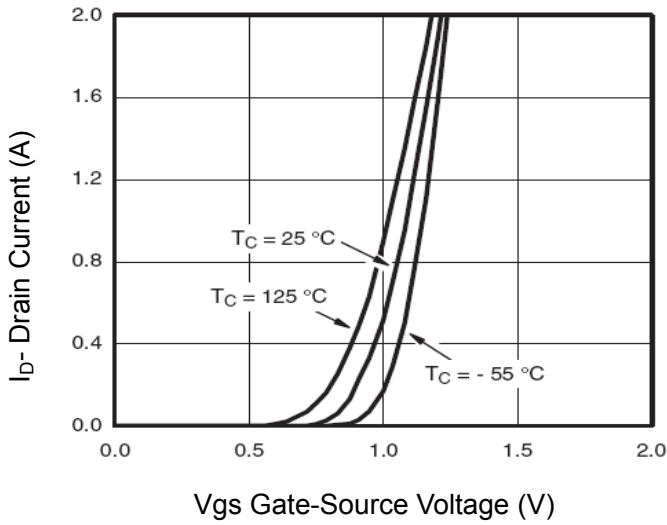
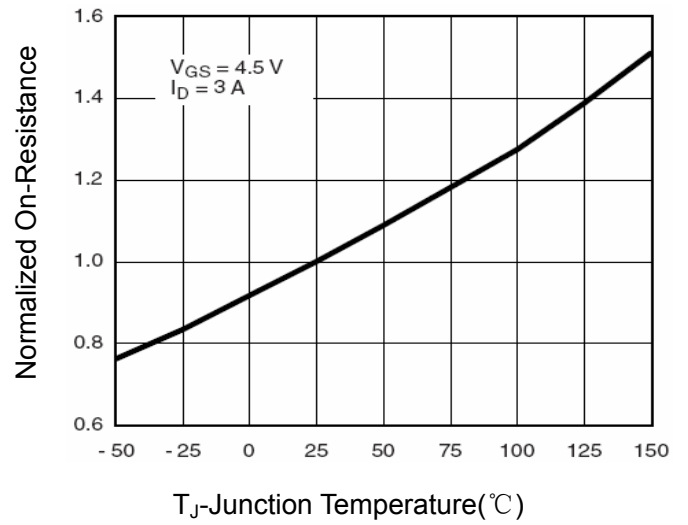


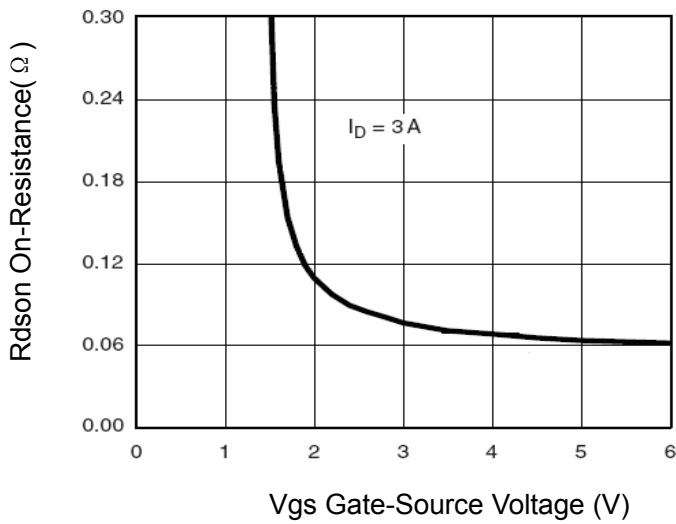
Figure 6 Drain-Source On-Resistance



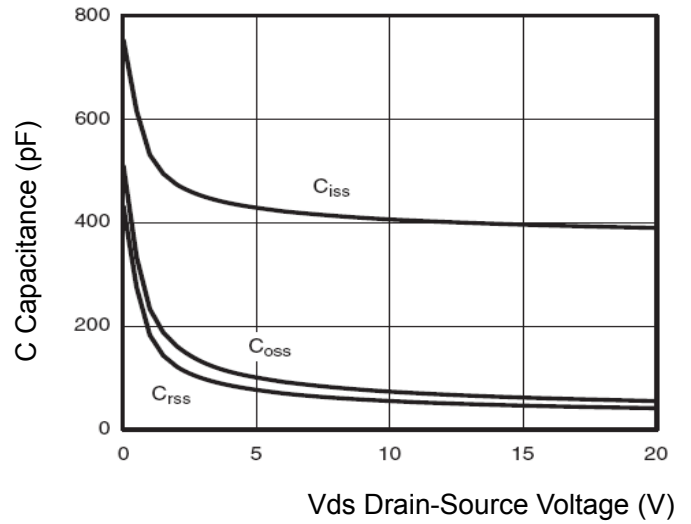
Vgs Gate-Source Voltage (V)  
**Figure 7 Transfer Characteristics**



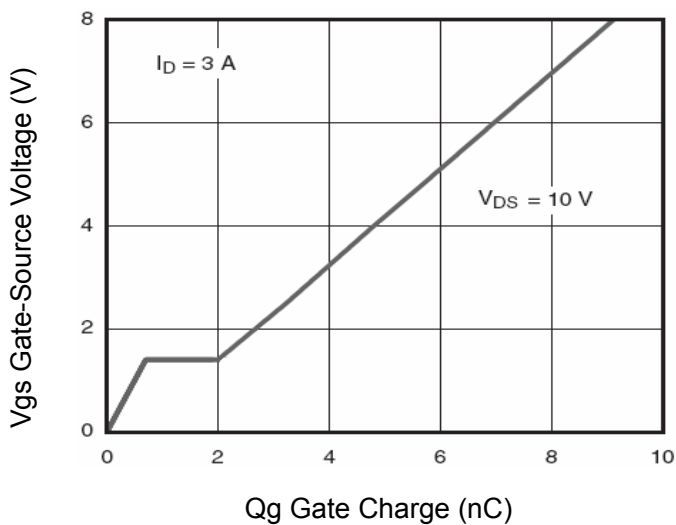
$T_J$ -Junction Temperature( $^\circ\text{C}$ )  
**Figure 8 Drain-Source On-Resistance**



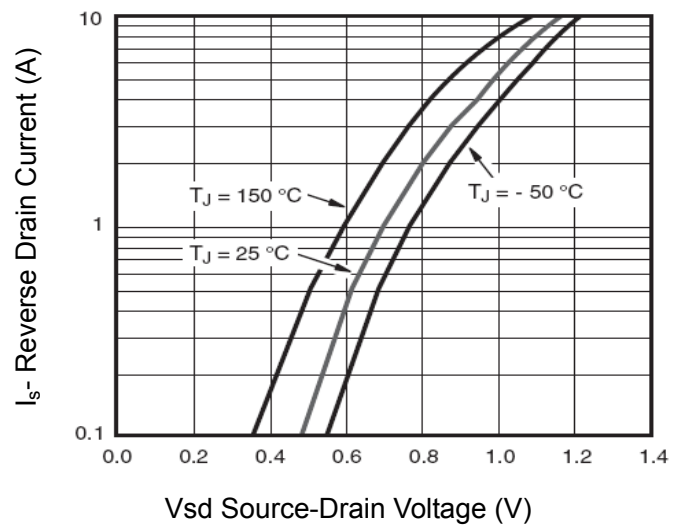
Vgs Gate-Source Voltage (V)  
**Figure 9 Rdson vs Vgs**



$V_{DS}$  Drain-Source Voltage (V)  
**Figure 10 Capacitance vs Vds**



$Q_g$  Gate Charge (nC)  
**Figure 11 Gate Charge**



$V_{SD}$  Source-Drain Voltage (V)  
**Figure 12 Source- Drain Diode Forward**

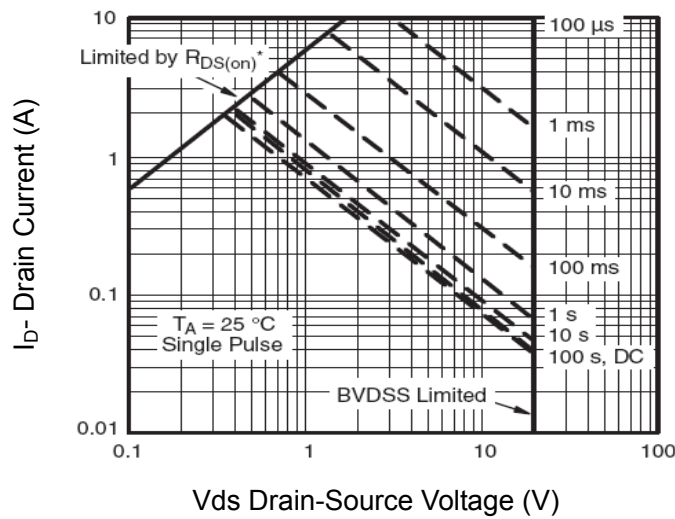


Figure 13 Safe Operation Area

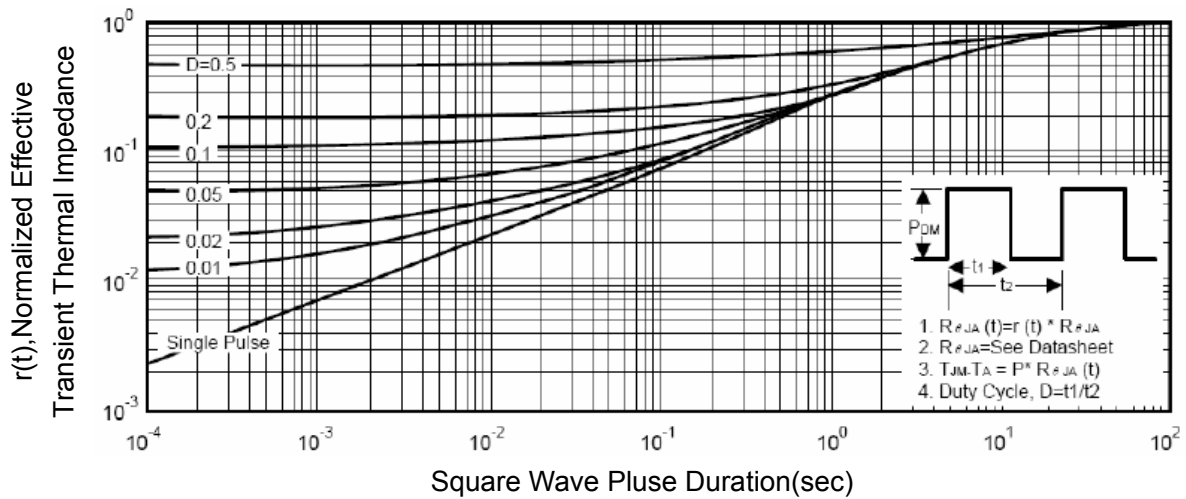
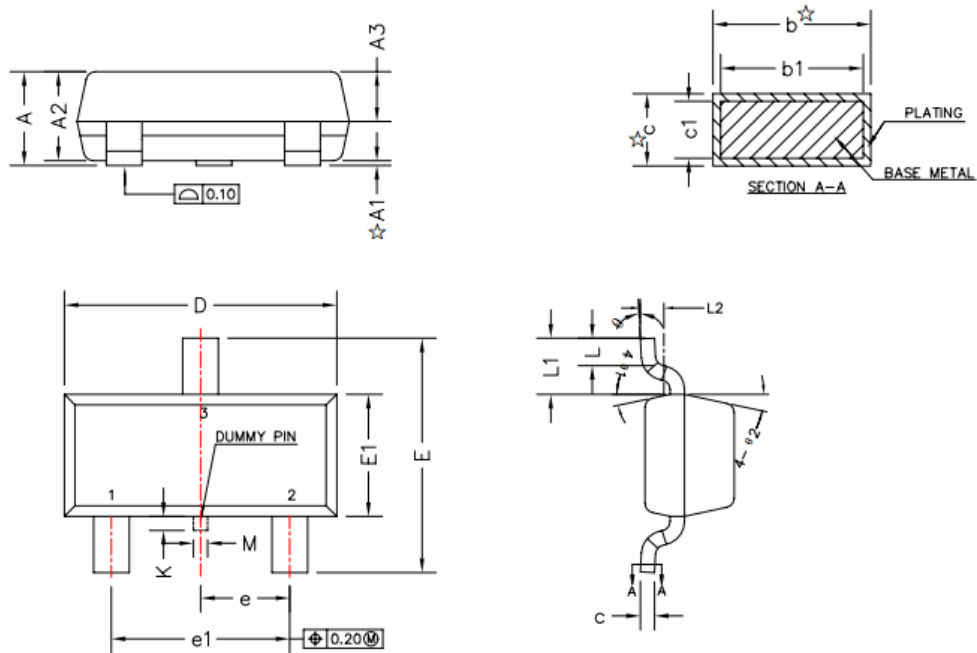


Figure 14 Normalized Maximum Transient Thermal Impedance

SOT-23 Package Information



Symbol	Millimeters	
	Min.	Max.
A	0.89	1.12
A1	0.01	0.10
A2	0.88	1.02
A3	0.43	0.63
b	0.36	0.50
b1	0.35	0.45
c	0.14	0.20
c1	0.14	0.16
D	2.80	3.00
E	2.35	2.64
E1	1.20	1.40
e	0.90	1.00
e1	1.80	2.00
L	0.40	0.60
L1	0.6REF	
L2	0.25BSC	
M	0.10	0.25
K	0.00	0.25
θ	0°	8°
θ1	10°	14°
θ2	10°	14°

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